Massive Early-Type Emission-Line Stars: An Attempt to Distinguish a New Group of Stellar Objects

By: A.S. Miroshnichenko, Yu.K. Bergner, D.B. Mukanov, T.A. Shejkina.

Miroshnichenko, A.S., Bergner, Yu.K., Mukanov, D.B., et al. 1995. *Ap&SS*, 224, 519 (Proc. of the Intern. Conference Circumstellar Matter-94). Massive early-type emission-line stars: an attempt to establish a new group of stellar objects. DOI: 10.1007/BF00667934

*****Note: Figures may be missing from this format of the document**

Made available courtesy of Springer: http://dx.doi.org/10.1007/BF00667934

Abstract:

A new sample of possibly massive early-type emission-line stars (METELS) based on the previous lists of peculiar Be stars is presented. It consists of 36 objects divided amongst supergiants, possible binaries, and candidates to the list. The central stars are probably more massive than ~10$M_{\odot}$. Two new relations allowing idientification of possible binaries among the objects are proposed.

Keywords: emission line stars — supergiants — binaries

Peculiar early-type stars show strong emission-line spectra which points to strong mass loss. Most of those known today were identified by Allen & Swings (1976) and Carlson & Henize (1979). The purposes of our study are (1) to analyse published data and studies of Bep stars, (2) to present an extended sample of such objects, (3) to separate possible subgroups in the sample and (4) to report relationships amongst observational characteristics of these objects. A new impulse for investigations of early-type stars with circumstellar (CS) envelopes came from the papers of Dong & Hu (1991) where the emission-line stars with strong IR excesses were separated on the basis of the catalogues of Wackerling (1970) and IRAS Point Sources, and of Thé et al. (1994) where the new catalogue of Herbig Ae/Be (HAEBE) and related objects was presented. From our and published results, we have formed a list of objects with the following characteristics: (1) estimated masses more than 10$M_{\odot}$, (2) possible supergiants with strong Hα and IR excesses, (3) a strong emission-line spectrum and early-B types but (4) not considered as Planetary Nebulae (PN) or symbiotic systems.

Our list consists of 36 objects divided into three subgroups:

1. Supergiants: P Cyg, η Car, AG Car, HR Car, HD 160529, WRA 751, He3-519, HD 87643, HDE 316285, CPD-52°9243, CPD-57°2874, HDE 326823, HDE 327083, 3 Pup, MWC 300, MWC 314, MWC 349,
2. Possible binaries: GG Car, HD 89249, XX Oph, MWC 84, MWC 297, MWC 342, MWC 623, MWC 930, MWC 1080,
3. Candidates: MWC 137, WRA 1484, CD-42°11721, HD 45677, HD 50138, He3-759, WRA 966, L_kH_α101, AS 78, LS II +22 8.

We argue that this group has to be studied separately from other groups of early-type emission-line stars, because it possibly represents an evolutionary sequence of stars. Most massive HAEBEs and symbiotics at early stages of their evolution can be contained in the sample.

During our study we obtained two interesting results for the objects of our list. Studying the diagram $Log\ S_{12}/S_{25}$ ~ $Log\ S_{12}/S_V$ we have found that several METELS with CS dust are situated in the region of late-type stars (MWC 84, MWC 623, CPD -52°9243, CPD -57°2784, HD 89249). MWC 623 and HD 89249 were suspected in binarity earlier (Zickgraf & Stahl 1989 and Stahl & Leitherer 1987, respectively). We have detected absorptions

of a late-type star in the spectrum of MWC 84 (Miroshnichenko 1994). Other stars are considered to be single objects.

The diagram of Balmer decrements $(Log(I_{H_\alpha}/I_{H_\beta}) \sim Log(I_{H_\gamma}/I_{H_\beta}))$ shows that single stars with strong CS envelopes and binaries with dominating late stars (symbiotics) are situated near the reddening line. Only several objects lie beyond the common relationship (MWC 84, MWC 930, XX Oph, HD 89249, CPD -52°9243). MWC 930 was suspected in binarity because it showed a quasi-periodic variability and absorptions of a late-type star (Miroshnichenko 1994).

In our opinion, the following steps must be made to accelerate investigations of METELS: (1) obtain homogeneous data on all METELS : photometry from UV to far IR, at least optical polarimetry, spectra of medium and high resolution, (2) to use as many as possible methods to determine interstellar reddening, (3) to organize a program to investigate METELS variability, (4) to make a search for new candidates to the list of METELS and (5) to model observational characteristics of METELS (emission-line profiles, SEDs, wavelength-dependence of polarization) in the framework of non-spherical envelope models (for example, Efstathiou Rowan-Robinson 1990 and de Araujo *et al*., 1994).

References:

Allen D.A. & Swings J.P.: 1976, *A&A* 47, 293
Carlson E.D. & Henize K.G.: 1979, *Vistas in Astronomy* 23, 213
de Araujo F.X., de Freitas Pacheco J.A. & Petrini D.: 1994, *MNRAS* 267, 501
Dong Yi-sun & Hu Jing-yao: 1991, *Chin. A&A*15, 275
Efstathiou A. & Rowan-Robinson M.: 1990, *MNRAS* 245, 275
Miroshnichenko A.S.: 1994, *Astronomical and Astrophysical Transactions* 5, 1
Stahl O. & Leitherer C.: 1987, *A&A* 177, 105
The P.S., de Winter D. & Perez M.R.: 1994, *A&AS* 104, 315
Wackerling L.R.: 1970, *Mem.RAS* 73, 153
Zickgraf F.-J. & Stahl 0.: 1989, *A&A* 223, 165